MDI-4000 Series

MDI-4000, MDI-4050, MDI-4100, MDI-4150

Low Profile, High-Performance, 2D Imager Engine

Specifications Manual

OPTICON

We scan, connect and communicate

The information in this document is subject to change without notice.

Limited Warranty and Disclaimers
Please read this manual carefully before installing or using the product.

Serial Number
A serial number appears on all Opticon products. This official registration number is directly related to the device purchased. Do not remove the serial number from your Opticon device. Removing the serial number voids the warranty.

Warranty
Unless otherwise agreed in a written contract, all Opticon products are warranted against defects in materials and workmanship for two years after purchase excluding batteries. Opticon will repair or, at its option, replace products that are defective in materials or workmanship with proper use during the warranty period. Opticon is not liable for damages caused by modifications made by a customer. In such cases, standard repair charges will apply. If a product is returned under warranty and no defect is found, standard repair charges will apply. Opticon assumes no liability for any direct, indirect, consequential or incidental damages arising out of use or inability to use both the hardware and software, even if Opticon has been informed about the possibility of such damages.

Packaging
The packing materials are recyclable. Damage caused by improper packaging during shipment is not covered by the warranty.

Trademarks
Trademarks used are the property of their respective owners.

Opticon Inc. and Opticon Sensors Europe B.V. are wholly owned subsidiaries of OPTOELECTRONICS Co., Ltd., 12-17, Tsukagoshi 4-chome, Warabi-shi, Saitama, Japan 335-0002. TEL +81-(0) 48-446-1183; FAX +81-(0) 48-446-1184

Support
USA
Phone: 800-636-0090
Email: support@opticonusa.com
Web: www.opticonusa.com

Europe
Phone: +31235692728
Email: support@opticon.com
Web: www.opticon.com

Revision History

This document is a compilation of all individual specification manuals for the MDI-4000 Series of scan engines.

Product Name: MDI-4000 Series Specifications Manual

Edition	Date	Page	Section	Description of Changes
First	June 13, 2019	-	-	Initial release.

Contents

Table of Figures

1 Overview

This manual provides specifications for the MDI-4000 Series 2D scan engine, which includes these models:

- MDI-4000 SR/HD/UD
- MDI-4050 SR/HD/UD
- MDI-4100 SR/HD/UD
- MDI-4150 SR/HD/UD

Use these specifications to smoothly integrate the MDI-4000 Series scan engine with your product and maximize performance of the scan engine.

Unless otherwise noted, all features apply to all models.

2 About the MDI-4000 Series Scan Engines

The MDI-4000 Series includes a multitude of 2D scan engines to meet your needs. These low-profile, high-performance scan engines can be integrated into any product to perform high-end tasks.

The MDI-4000 Series contains these features:

- **Super thin 2D imager scan engine:** The MDI-40x0 and MDI-41x0 with a separate decoder have ultra low-profiles: 6 mm and 9.7 mm, respectively. This minimal height allows the scan engines to be easily integrated into even the most compact equipment, such as PDAs, data collectors, and ticket readers.
- **High-speed reading:** The extreme high-performance decoder ensures stress-free scanning and fast response, even in the case of poor-quality barcodes (such as damaged or low-contrast), movement/vibration, and poor lighting conditions.
- **High-speed image sensor:** The high-speed CMOS image sensor captures images at a speed of up to 100 fps, which when combined with the fastest global shutter speed in the industry, enables fast and accurate scanning.
- **Ultra-fast image processing:** The high-performance and low-power 800MHz CPU enables a smooth response by processing the vast amount of information transferred by the 100fps CMOS image sensor in a very short time.
- **Editing function:** Captures up to 16 barcodes at a time on multiple images. The output editing process, such as GS1 format, can also be configured easily.
- **Data Edit Programming:** Capable of batch reading 1D codes (up to 16 barcodes), 2D barcodes, and OCR. The combined output is highly configurable using regular expressions. Also supports GS1 data conversion and code coordinate output.
- **Low power consumption:** The power consumption in operating, standby, and low power states has been drastically minimized. Various power saving settings can be configured to optimize the power consumption for your particular application. The MDI-4x50 is specifically designed to save power in Sleep low power mode, which is why the MDI-4x50 is recommended for battery-powered devices.
- **Green LED aiming and Warm-White LED Illumination:** A well-defined, single line of green LED light and efficient warm-white LED illumination makes it easy to aim the scanner while providing safety and long life.
- **RoHS compliance:** The scan engines are RoHS compliant products, as declared by Optoelectronics Co., Ltd.

Use the next illustration to determine which scan engine model best meets your needs.

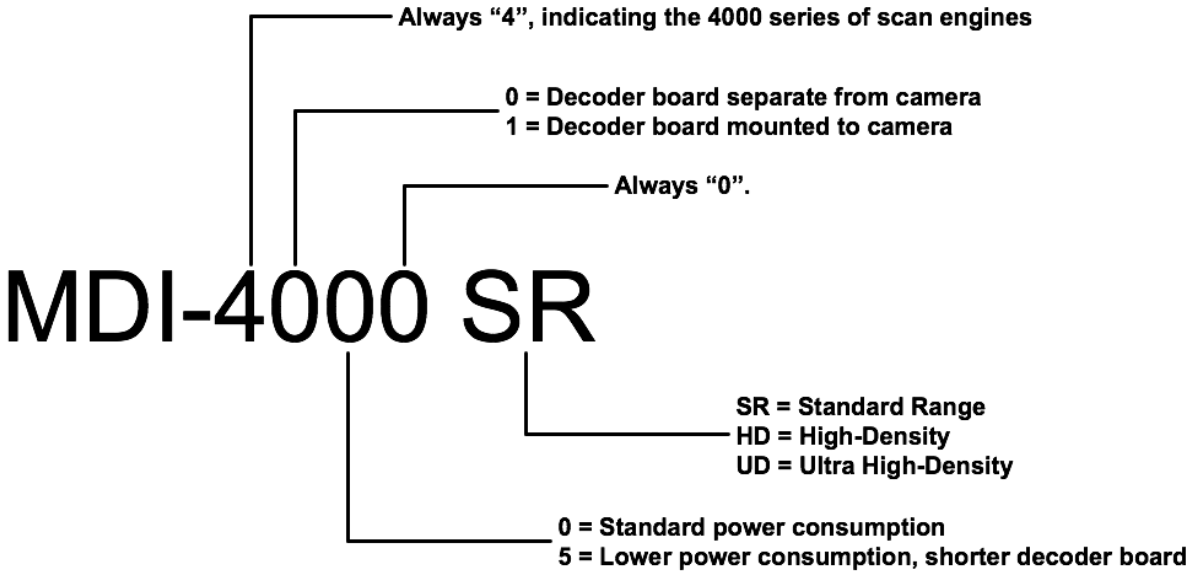


Figure **1***: MDI-4000 Series Model Number Description*

3 Physical Features

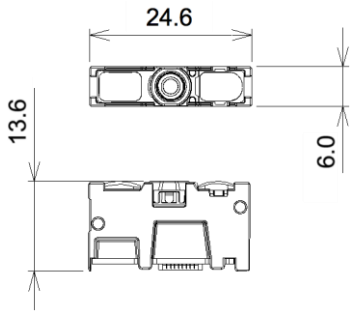
3.1 Dimensions

3.1.1 MDI-4000 and MDI-4050 Dimensions

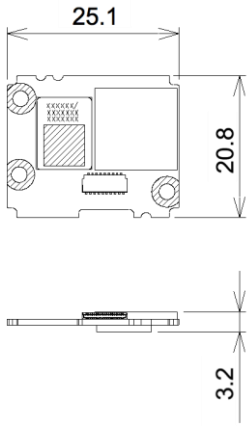
These dimensions are for the individual components of the MDI-4000 and MDI-4050.

Camera

W: 24.6 mm × D: 13.6 mm × H: 6.0 mm



Decoder Board
W: 25.1 mm × D: 20.8 mm × H: 3.2 mm



FPC
Note: This cable, between the camera and decoder board, is supplied with each scan engine.

W: 6.0 mm × D: 24.0 mm × H: 5.4 mm

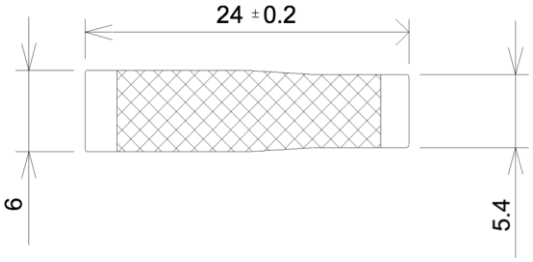


Figure **2***: Dimensions of the Components of the MDI-4000 and MDI-4050*

3.1.2 MDI-4100 and MDI-4150 Dimensions

Imager Engine
W: 25.3 mm × D: 21.0 mm × H: 9.7 mm

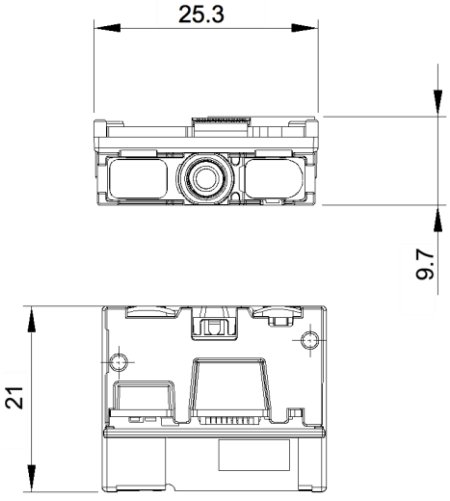


Figure **3***: Dimensions of the MDI-4100 and MDI-*4150

3.2 Weight

Imager Engine: 5.5 grams (max)

4 Electrical Specifications

4.1 Absolute Maximum Ratings

Note: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute maximum rated conditions for extended periods of time may affect device reliability.

Voltage	Rated Value	Unit
Power Supply Voltage (VCC to GND) (V_{CC})	-0.3 to 7.0	V
Input Voltage (V_I)	-0.3 to V_{CC} +0.3	V

4.2 Recommended Operating Conditions*1

Voltage/Current		Symbol	Conditions	Min.	Typ.	Max.
Supply Voltage (V)		V_{CC}		3.0	3.3/5.0	5.5
Input Voltage (V)	Low	V_{IL}		0	-	0.15
	High	V_{IH}		V_{CC} -0.4	-	V_{CC}
Output Voltage (V)	Low	V_{OL}	I_{OL} = 600µA		-	0.55
	High	V_{OH}	I_{OH} = -20µA	0.67*V_{CC}	-	V_{CC}
Output Current (mA)*2	Low	I_{OL}	V_{CC} = 3.0V			-4
	High	I_{OH}	V_{CC}= 3.0V			4

*1 Measured at connector.
*2 Applies to all output pins.

4.3 Current Consumption

V_{CC} = 3.3V/5.0V IF:UART/USB, T_A = 25°C

Current	State	Symbol	Conditions	Min.	Typ.	Max.
Peak Rush Current (mA)	Boot	I_{PK}*	-	-	800	1000

* Measured at the scan engine connector.

UART

V_{CC} = 3.3V IF:UART, T_A = 25°C

Current	State	Recovery Time*1	Conditions	Min.	Typ.	Max.
Operating Current (mA)	Read (I_{OP})	-	-	-	300	450
Standby Current (mA)	Standby (I_{STB})	0 ms	-	-	26	
	Low Power (I_{LOW})	41 ms (MDI-4x50) 18 ms (MDI-4x00)	Configured*2	-	1 (MDI-4x50) 9 (MDI-4x00)	

*1 Recovery time is the time from when the trigger is pressed to when the engine is ready to scan.

*2 For details, see the “MDI-4xx0 Serial Interface Specifications Manual.”

V_{CC} = 5.0V IF:UART, T_A = 25°C

Current	State	Recovery Time*1	Conditions	Min.	Typ.	Max.
Operating Current (mA)	Read (I_{OP})	-	-	-	210	320
Standby Current (mA)	Standby (I_{STB})	0 ms	-	-	20	
	Low Power (I_{LOW})	41ms (MDI-4x50) 18ms (MDI-4x00)	Configured*2	-	0.9 (MDI-4x50) 10 (MDI-4x00)	

*1 Recovery time is the time from when the trigger is pressed to when the engine is ready to scan.
*2 For details, see the “MDI-4xx0 Serial Interface Specifications Manual.”

USB

V_{CC} = 3.3V IF:USB, T_A = 25°C

Current	State	Recovery Time*1	Conditions	Min.	Typ.	Max.
Operating Current (mA)	Read (I_{OP})	-	-	-	300	450
Standby Current*2 (mA)	Standby (I_{STB})	0 ms	-	-	28	
	Suspend (I_{SUS})	43 ms (MDI-4x50) 18 ms (MDI-4x00)	Configured*3	-	1.5 (MDI-4x50) 9 (MDI-4x00)	

*1 Recovery time is the time from when the trigger is pressed to when the engine is ready to scan.
*2 These values apply when USB is in “Selective Suspend” mode. In this mode, certain USB ports are put into suspended mode to save power. When using the USB as a virtual COM port (USB-COM), use the “Opticon USB Code Reader” driver version 3.x.x.x. or later.
*3 The current is measured when Standby is set to Low Power.

V_{CC} = 5.0V IF:USB, T_A = 25°C

Current	State	Recovery Time*1	Conditions	Min.	Typ.	Max.
Operating Current (mA)	Read (I_{OP})	-	-	-	210	320
Standby Current*2 (mA)	Standby (I_{STB})	0 ms	-	-	20	
	Suspend (I_{SUS})	43 ms (MDI-4x50) 18 ms (MDI-4x00)	Configured*3	-	1.2 (MDI-4x50) 10 (MDI-4x00)	

*1 Recovery time is the time from when the trigger is pressed to when the engine is ready to scan.
*2 These values apply when USB is in “Selective Suspend” mode. In this mode, certain USB ports are put into suspended mode to save power. When using the USB as a virtual COM port (USB-COM), use the “Opticon USB Code Reader” driver version 3.x.x.x. or later.
*3 The current is measured when Standby is set to Low Power.

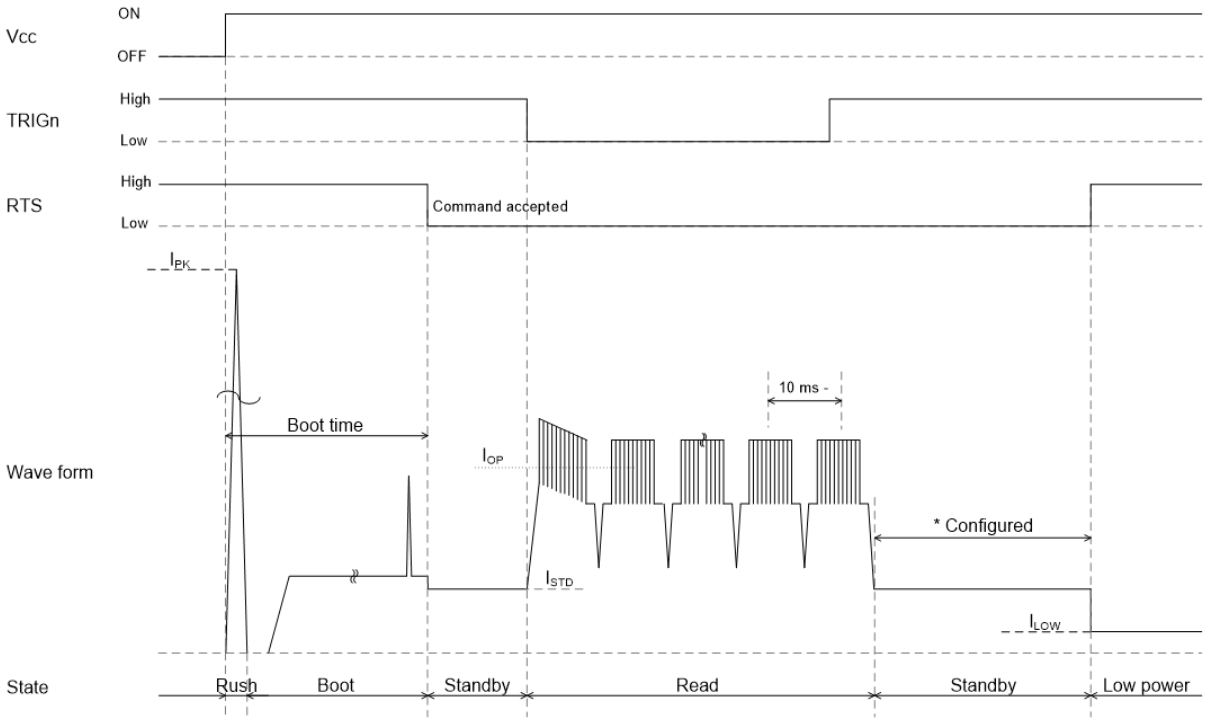
4.4 Recovery Time

V_{CC} = 3.3V, 5.0V IF:UART/USB, T_A = 25°C

Time	Mode	Conditions	Min.	Typ.	Max.
Boot Time (ms)	Normal Boot	-	-	510	
	Fast Boot Mode	Configured*	-	425	

* For details, see the "MDI-4xx0 Serial Interface Specifications Manual."

4.5 Current Waveform

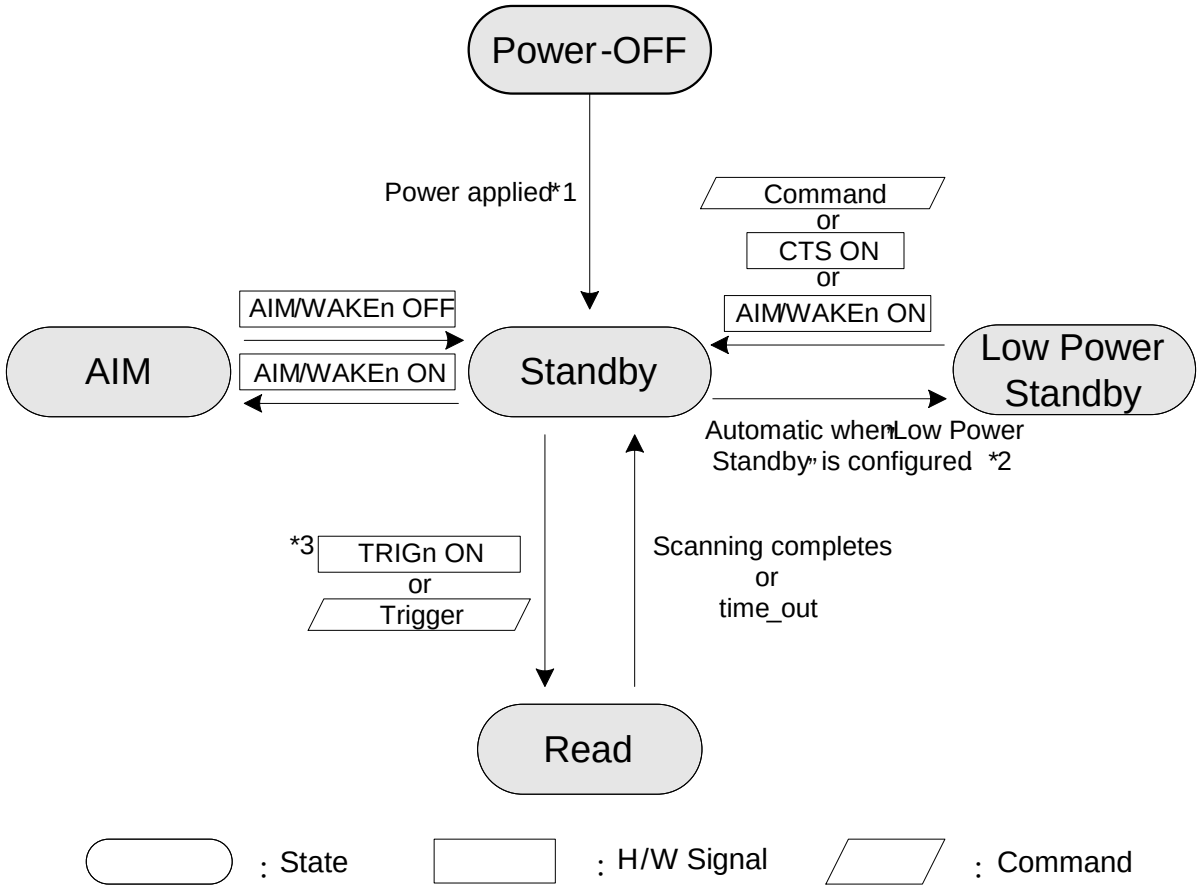


* When Low Power Mode is enabled, the scan engine automatically enters Low Power state after power on.

*Figure **4**: Current Waveform*

OPTICON

5 Power Mode Transition



*1 These options are available to reduce start-up time: Fast Boot and Normal Boot. For details, see the "MDI-4xx0 Serial Interface Specifications Manual."
*2 When Low Power Standby is enabled, the scan engine automatically enters Low Power state after power on.
*3 The Hardware Trigger (or Z Trigger) command moves from the Low Power state to the Read state.

Figure **5***: Power Mode Transition*

6 Interface Specifications

6.1 Interface Signals

Connector used is equivalent to the one produced by IRISO Electronics Co., Ltd.

Product No.: 9681-12 (12pin, 0.5mm pitch bottom contact, 0.3mm thick FPC/FFC connector)

Interface Signals

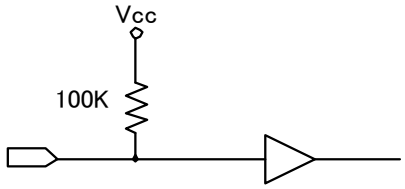
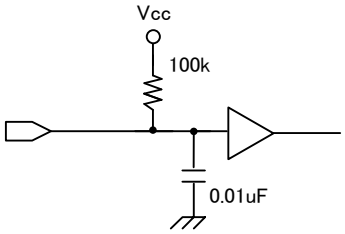
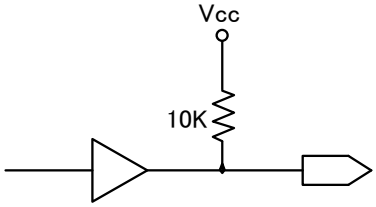
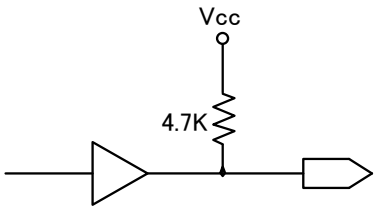
No.	Name	Function	I/O	Conditions	State	Notes
1	TRIGn	Trigger	In		L: Start operation H: No action	100kΩ pull up and 10nF capacitor on scan engine
2	AIM/WAKEn	Recovery signal from Low Power state	In		L: Recover from low power state H: No action	100kΩ pull up on scan engine
		Aiming control signal in other states than Low Power	In		L: Aiming LED on H: Aiming LED off	
3	GR_LEDn	Good read LED	Out		L: LED on H: LED off	100kΩ pull up on scan engine
	EX_ILLUM	Control of an external light source.	Out	Configured	L: External Illumination On H: External Illumination Off	
4	BUZZERn	Buzzer	Out		ACTIVE: PWM signal (frequency and duration configurable) IDLE: Steady high or low (configurable idle state)	A transistor or FET should be used to drive a buzzer. 100kΩ pull up on scan engine
5	POWERDWN	Indicates Low Power state	Out		L: Normal state H: Low Power state	100kΩ pull up on scan engine
6	RTS	Communication control signal to host system	Out			10kΩ pull up on scan engine
7	CTS	Communication control signal from host system	In	Interface configured as UART		100kΩ pull up on scan engine
	USB+	D+ signal for USB	In/ Out	Interface configured as USB		
8	TxD	Transmitted data signal	Out			10kΩ pull up on scan engine

Interface Signals (*continued*)

No.	Name	Function	I/O	Conditions	State	Notes
9	RxD	Received data signal	In	Interface configured as UART		100kΩ pull up on scan engine
	USB-	D- signal for USB	In/ Out	Interface configured as USB		
10	GND	System ground				
11	VCC	Power input	In		3.3V / 5.0V	
12	Reserve		In			N.C.

* For details, see the "MDI-4xx0 Serial Interface Specifications Manual."

6.2 Interface Circuit

Signal Name	Circuit
AIM/WAKEn RxD CTS	
TRIGn	
RTS TxD	
GR_LEDn	

Interface Circuit (*continued*)

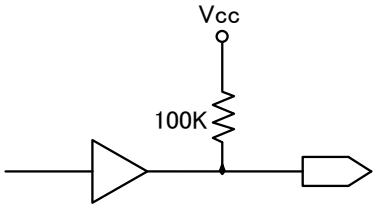
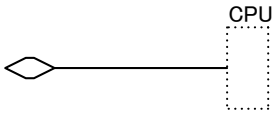
Signal Name	Circuit
BUZZERn POWERDWN	
USB+ USB-	

Figure **6***: Interface Circuit*

7 Optical Specifications

7.1 Basic Optical Specifications

Specification		Characteristics
Scan method	CMOS array area sensor	(black and white)
Number of effective pixels	(H) × (V)	640 × 480
Image capture speed	Frame rate*1	100 fps
Sensor shutter speed	Minimum shutter speed	30µs
Focal distance	From the front edge of scan engine	115 mm (SR models) 65 mm (HD models) 45 mm (UD models)
View angle	Horizontal	Approx. 38.0°
	Vertical	Approx. 28.9°
	Diagonal	Approx. 46.4°
Auxiliary light source (LED x 1)	Warm white LED	-
	Color temperature	2600 to 3700K
	Maximum Optical Efficiency*2	114 lm/W
Light source for aiming (LED x 1)	Single Line Green LED	-
	Peak Wave Length	535nm
	Maximum Optical Efficiency*2	87.4 lm/W

*1 The fastest speed of image capture.
*2 The reference value extracted from the LED datasheet.

7.2 Aiming Specifications

Aiming is used to indicate the appropriate reading distance by projecting a bar of green light. The aiming specifications are as follows:

- The optical axis of the imaging field of view and the center of the horizontal aiming bar coincide at a distance of L=150±40 mm from the front edge of the engine.
- The width of the aiming bar at a distance of L=150mm is 90%±10% of the width of the field of view.
- The sharpest aiming bar distance is 150 ± 10 mm (SR models), 65 ± 10 mm (HD models) or 45 ± 10 mm (UD models).

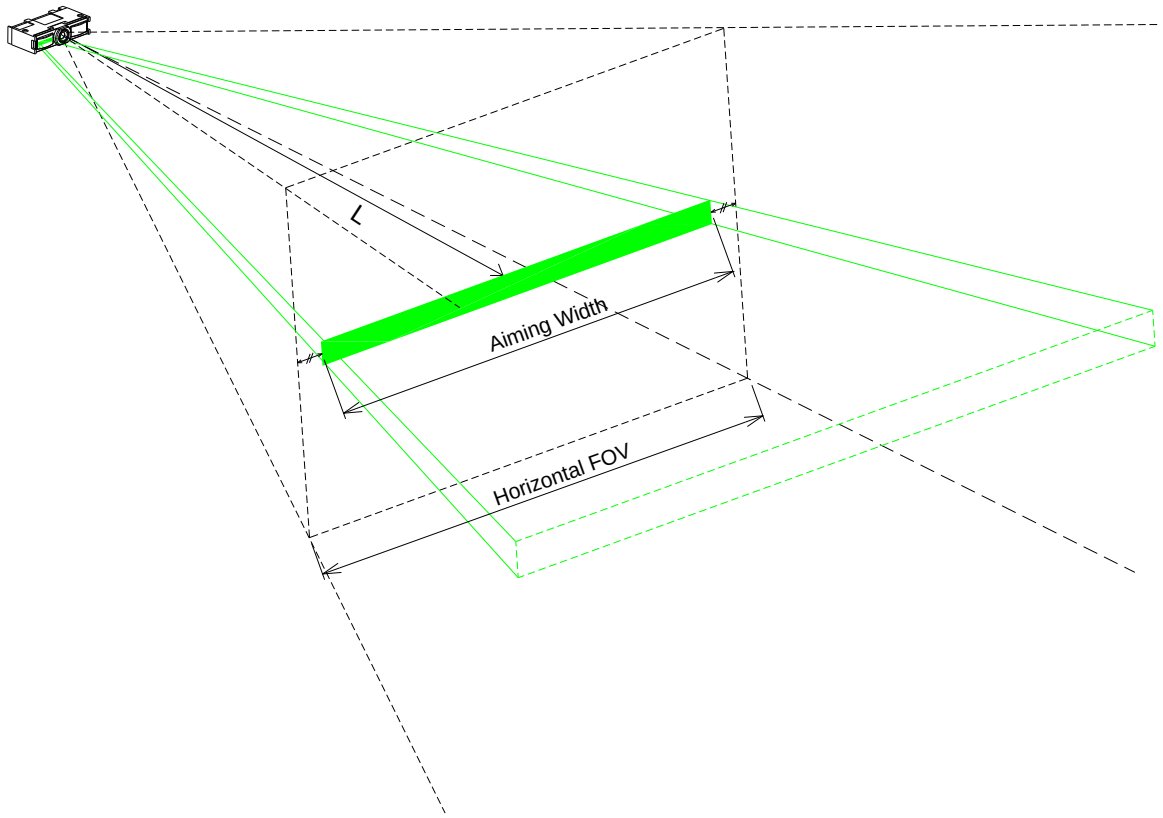


Figure ***7****: Aiming Pattern*

8 Technical Specifications

The conditions for technical specifications are as follows, unless otherwise specified in each section.

Technical Specification Conditions

Specification	Condition
Ambient Temperature and Humidity	Room temperature and room humidity
Ambient Light	100 to 200 lux (on the surface of a barcode)
Pitch Angle	α= 0°
Skew Angle	β = 15°
Tilt Angle	γ = 0°
Code Position	Center of the image
Curvature	R = ∞
Power Supply Voltage	3.3 and 5.0 V
PCS (1D and 2D)	0.9 or higher
Scanning Test	Accept the performance with 90% or more success rate for 10 scan attempts.
Barcode Test Sample (1D and 2D)	Specified below

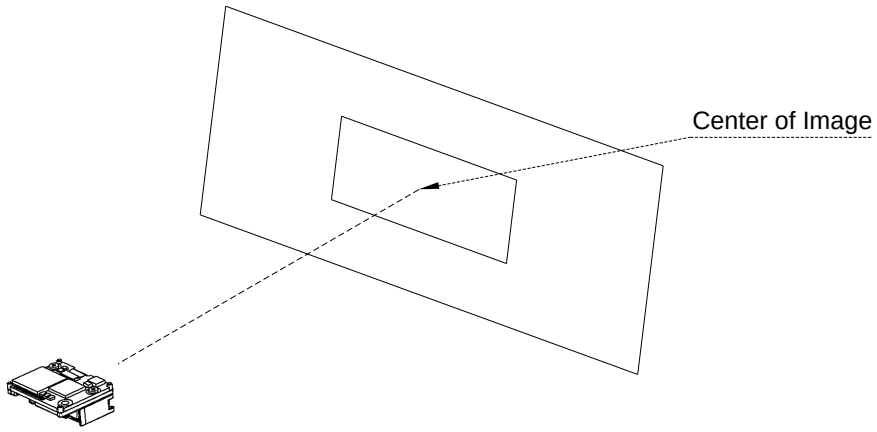


Figure **8***: Test Condition for Depth of Field*

8.1 Barcode Test Labels

This section describes the barcode labels used when the depth of field was measured.

1D Barcode Test Labels

Code 39

Resolution	Symbology	PCS (MRD)	Size (mm)	No. of Digits
0.051 mm (2 mil)	Code 39	0.9 (80)	5 × 10	5
0.076 mm (3 mil)			26 × 10	10
0.1 mm (4 mil)			26 × 10	16
0.127 mm (5 mil)			11 × 10	4
0.20 mm (7.9 mil)			100 × 10	31
0.254 mm (10 mil)			32.5 × 10	7
0.508 mm (20 mil)			43 × 25	4

Code 128

Resolution	Symbology	PCS (MRD)	Size (mm)	No. of Digits
0.20 mm (7.9 mil)	Code 128	0.9 (80)	52 × 10	16

UPC/EAN

Resolution	Symbology	PCS (MRD)	Size (mm)	No. of Digits
0.330 mm (13 mil)	UPC/EAN	0.9/0.2 (80/13)	31.5 × 24.5	12/13

GS1 Databar / Composite Test Labels

GS1-DataBar Limited

Resolution	Symbology	PCS (MRD)	Size (mm)	No. of Digits
0.127 mm (5.0 mil)	Limited	0.9 (80)	9.0 × 1.0	14
0.127 mm (5.0 mil)	Limited-Composite		9.0 × 2.5	26
0.169 mm (6.7 mil)	Limited		12 × 1.8	14
0.169 mm (6.7 mil)	Limited-Composite		12 × 3.0	26

2D Test Barcodes

PDF417

Resolution	Error Correction	PCS (MRD)	Size (mm)	No. of Characters
0.127 mm (5 mil)	Level-3	0.9 (80)	12 x 8	58
0.169 mm (6.7 mil)			23 x 10	
0.254 mm (10 mil)			35 x 15	

QR Code: Model-2

Resolution	Error Correction	PCS (MRD)	Size (mm)	No. of Characters
0.084 mm (3.3 mil)	M	0.9 (80)	2.8 × 2.8	44
0.127 mm (5 mil)	M	0.9 (80)	4 x 4	44
0.169 mm (6.7 mil)			5 x 5	
0.381 mm (15 mil)			11 x 11	

Data Matrix

Resolution	Error Correction	PCS (MRD)	Size (mm)	No. of Characters
0.084 mm (3.3 mil)	ECC200	0.9 (80)	2 x 2	40
0.127 mm (5 mil)	ECC200	0.9 (80)	3 x 3	40
0.169 mm (6.7 mil)			4 x 4	
0.254 mm (10 mil)			6 x 6	

Note: Size is measured using the outline dimensions excluding the quiet zone.

8.2 Scan Area and Depths of Field

The scan area is measured from the front edge of the scan engine. The depth of field depends on the view angle and symbol length. The depth of field values provided are the typical values measured at an ambient temperature of 25°C.

The focal point of the camera, and therefore the depth of field, is different for the SR, HD, and UD models. This section describes the depths of field for all three models.

8.2.1 Scan Area and Depths of Field for SR Models

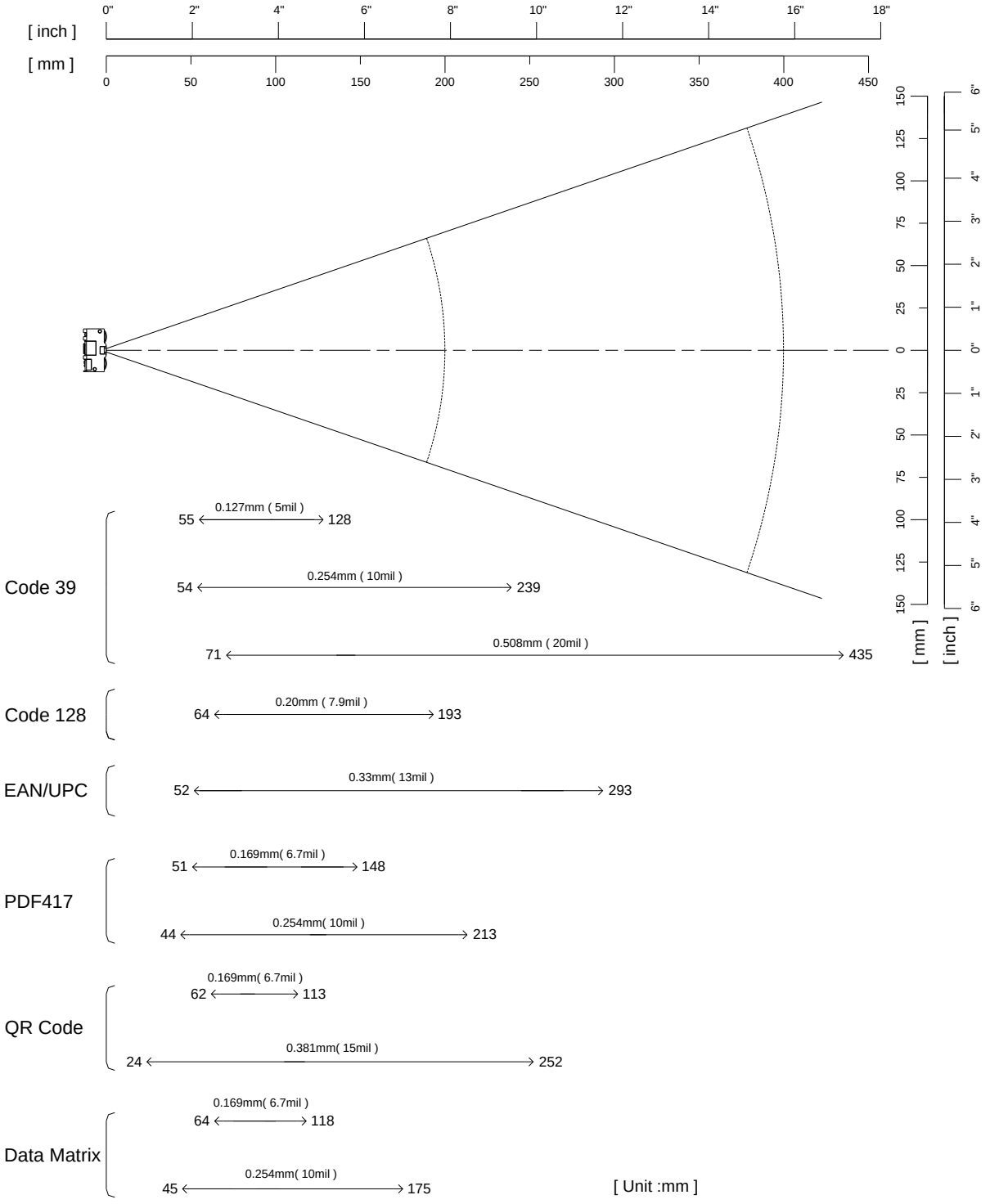


Figure **9***: Scan Area and Depths of Field for SR Models*

Depths of Field for SR Models

T_A = 25°C

Resolution	Symbology Type	PCS (MRD)	Guaranteed Value		Typical Value	
			Near	Far	Near	Far
0.127 mm (5 mil)	Code 39	0.9 (0.8)	66 mm (2.6″)	112 mm (4.4″)	55 mm (2.1″)	128 mm (5.0″)
0.254 mm (10 mil)	Code 39	0.9 (0.8)	64 mm (2.5″)	211 mm (8.3″)	54 mm (2.1″)	239 mm (9.4″)
0.508 mm (20 mil)	Code 39	0.9 (0.8)	86 mm (3.4″)	373 mm (14.6″)	71 mm (2.8″)	435 mm (17.1″)
0.2 mm (7.9 mil)	Code 128	0.9 (0.8)	79 mm (3.1″)	167 mm (6.6″)	64 mm (2.0″)	193 mm (7.6″)
0.33 mm (13 mil)	UPC/EAN	0.9 (0.8)	64 mm (2.5″)	250 mm (9.8″)	52 mm (2.0″)	293 mm (11.5″)
0.169 mm (6.7 mil)	PDF417	0.9 (0.8)	59 mm (2.3″)	131 mm (5.1″)	51mm (2.0″)	148 mm (5.8″)
0.254 mm (10 mil)	PDF417	0.9 (0.8)	55 mm (2.1″)	185 mm (7.3″)	44 mm (1.7″)	213 mm (8.4″)
0.169 mm (6.7 mil)	QR Code	0.9 (0.8)	75 mm (2.9″)	99 mm (3.9″)	62 mm (2.4″)	113 mm (4.4″)
0.381 mm (15 mil)	QR Code	0.9 (0.8)	29 mm (1.2″)	216 mm (8.5″)	24 mm (1.0″)	252 mm (9.9″)
0.169 mm (6.7 mil)	Data Matrix	0.9 (0.8)	77 mm (3.0″)	103 mm (4.0″)	64 mm (2.5″)	118 mm (4.6″)
0.254 mm (10 mil)	Data Matrix	0.9 (0.8)	57 mm (2.2″)	151 mm (5.9″)	45 mm (1.8″)	175 mm (6.8″)

8.2.2 Scan Area and Depths of Field for HD Models

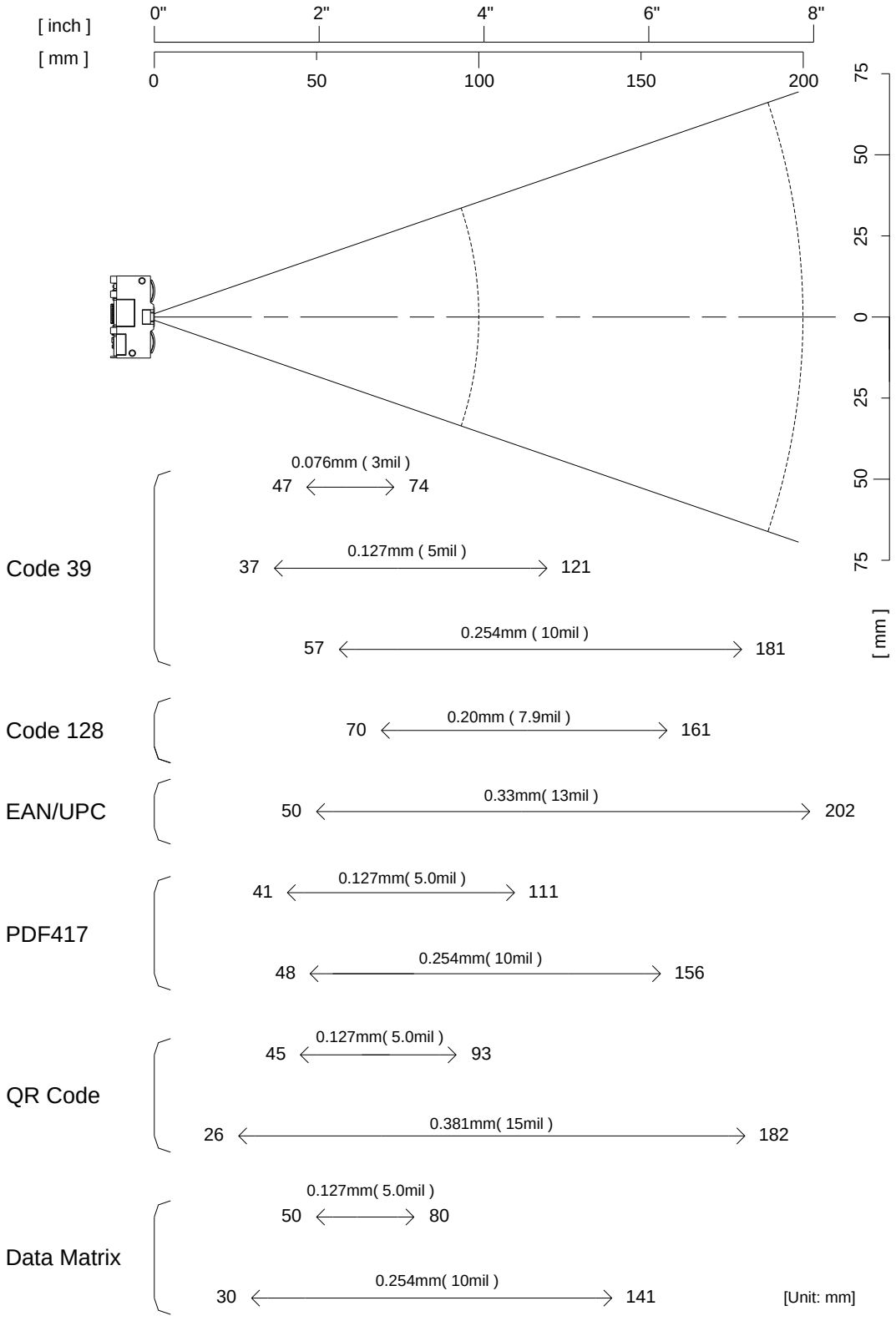


Figure **10***: Scan Area and Depths of Field for HD Models*

Depths of Field for HD Models

T_A = 25°C

Resolution	Symbology Type	PCS (MRD)	Guaranteed Value		Typical Value	
			Near	Far	Near	Far
0.076 mm (3 mil)	Code 39	0.9 (0.8)	55 mm (2.2″)	65 mm (2.5″)	47 mm (1.9″)	74 mm (2.9″)
0.127 mm (5 mil)	Code 39	0.9 (0.8)	45 mm (1.8″)	104 mm (4.1″)	37 mm (1.5″)	121 mm (4.8″)
0.254 mm (10 mil)	Code 39	0.9 (0.8)	64 mm (2.5″)	157 mm (6.2″)	57 mm (2.3″)	181 mm (7.1″)
0.2 mm (7.9 mil)	Code 128	0.9 (0.8)	79 mm (3.1″)	140 mm (55″)	70 mm (2.8″)	161 mm (6.3″)
0.33 mm (13 mil)	UPC/EAN	0.9 (0.8)	64 mm (2.5″)	173 mm (6.8″)	50 mm (2.0″)	202 mm (8.0″)
0.127mm (5.0 mil)	PDF417	0.9 (0.8)	48 mm (1.9″)	97 mm (3.8″)	41 mm (1.6″)	111 mm (4.4″)
0.254 mm (10 mil)	PDF417	0.9 (0.8)	53 mm (2.1″)	137 mm (5.4″)	48 mm (1.9″)	156 mm (6.1″)
0.127 mm (5.0 mil)	QR Code	0.9 (0.8)	51 mm (2.0″)	81 mm (3.2″)	45 mm (1.8″)	93 mm (3.7″)
0.381 mm (15 mil)	QR Code	0.9 (0.8)	33 mm (1.3″)	155 mm (6.1″)	26 mm (1.0″)	182 mm (7.2″)
0.127 mm (5.0 mil)	Data Matrix	0.9 (0.8)	57 mm (2.3″)	65 mm (2.5″)	50 mm (2.0″)	80 mm (3.1″)
0.254 mm (10 mil)	Data Matrix	0.9 (0.8)	37 mm (1.5″)	122 mm (4.4″)	30 mm (1.2″)	141 mm (5.6″)

8.2.3 Scan Area and Depths of Field for UD Models

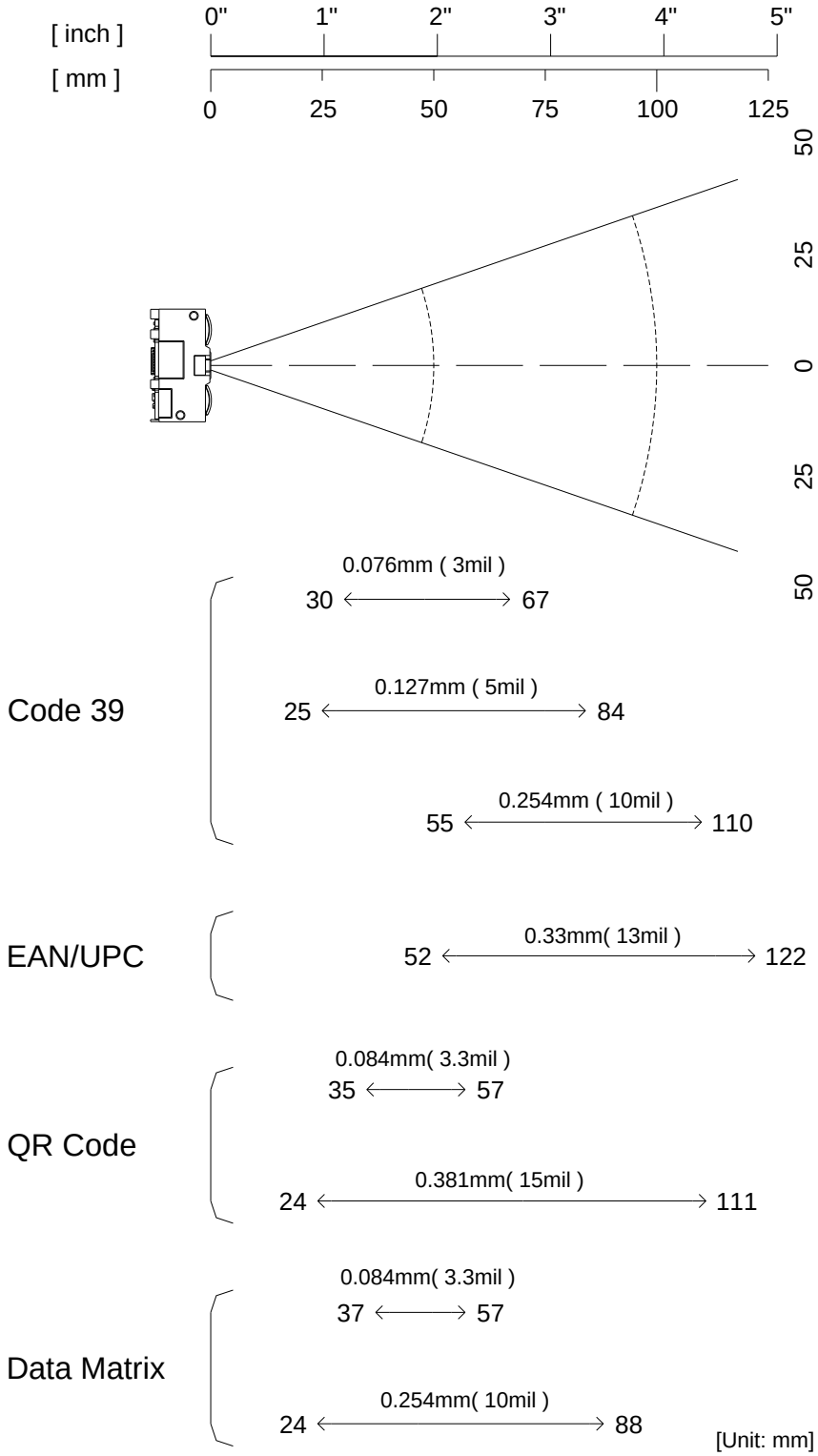


Figure **11***: Scan Area and Depths of Field for UD Models*

Depths of Field for UD Models

T_A = 25°C

Resolution	Symbology Type	PCS (MRD)	Guaranteed Value		Typical Value	
			Near	Far	Near	Far
0.076 mm (3 mil)	Code 39	0.9 (0.8)	37 mm (1.5″)	58 mm (2.3″)	30 mm (1.2″)	67 mm (2.6″)
0.127 mm (5 mil)	Code 39	0.9 (0.8)	37 mm (1.5″)	70 mm (2.8″)	25 mm (1.0″)	84 mm (3.3″)
0.254 mm (10 mil)	Code 39	0.9 (0.8)	66 mm (2.6″)	95 mm (3.7″)	55 mm (2.2″)	110 mm (4.3″)
0.33 mm (13 mil)	UPC/EAN	0.9 (0.8)	68 mm (2.7″)	104 mm (4.1″)	52 mm (2.1″)	122 mm (4.8″)
0.084 mm (3.3 mil)	QR Code	0.9 (0.8)	44 mm (1.7″)	47 mm (1.9″)	35 mm (1.4″)	57 mm (2.2″)
0.381 mm (15 mil)	QR Code	0.9 (0.8)	31 mm (1.2″)	94 mm (3.7″)	24 mm (0.9″)	111 mm (4.4″)
0.084 mm (3.3 mil)	Data Matrix	0.9 (0.8)	45 mm (1.8″)	50 mm (2.0″)	37 mm (1.5″)	57 mm (2.2″)
0.254 mm (10 mil)	Data Matrix	0.9 (0.8)	35 mm (1.4″)	74 mm (2.9″)	24 mm (0.9″)	88 mm (3.5″)

8.3 Print Contrast Signal (PCS)

PCS: 0.2 or higher for SR and HD models
0.3 for UD models

PCS Conditions

Condition	Description
MRD	13 and higher (SR and HD models) 23 and higher (UD models) (70% or higher reflectivity of space and quiet zone)
Distance	130 mm from the front edge of the scan engine (SR and HD models) 80 mm from the front edge of the scan engine (UD models)
Barcode Sample	UPC specified in Chapter 8. (Resolution: 0.33 mm, PCS: 0.2)

MRD = Minimum reflectance of white space - Maximum reflectance of black bar

$$PCS = \frac{\text{Reflectance of white space - Reflectance of black bar}}{\text{Reflectance of white space}}$$

8.4 Minimum Resolution

8.4.1 Minimum Resolution for SR Models

For details, see section “8.2.1 Scan Area and Depths of Field for SR Models.”

Minimum Resolution

Barcode	Symbology	Minimum Resolution
1D Code	Code 39	0.1 mm (4 mil)
GS1-Databar	GS1 DataBar Limited	0.169 mm (6.7 mil)
Stacked Code	PDF417, GS1 DataBar Limited Composite	0.169 mm (6.7 mil)
2D Code	QR Code, Data Matrix	0.169 mm (6.7 mil)

Minimum Resolution Conditions

Condition	Description
Distance	85 mm from the front edge of the scan engine
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

8.4.2 Minimum Resolution for HD Models

For details, see section “8.2.2 Scan Area and Depths of Field for HD Models.”

Minimum Resolution

Barcode	Symbology	Minimum Resolution
1D Code	Code 39	0.076 mm (3 mil)
GS1-Databar	GS1 DataBar Limited	0.127 mm (5 mil)
Stacked Code	PDF417, GS1 DataBar Limited Composite	0.127 mm (5 mil)
2D Code	QR Code, Data Matrix	0.127 mm (5 mil)

Minimum Resolution Conditions

Condition	Description
Distance	60 mm from the front edge of the scan engine
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

8.4.3 Minimum Resolution for UD Models

For details, see section “8.2.3 Scan Area and Depths of Field for UD Models.”

Minimum Resolution

Barcode	Symbology	Minimum Resolution
1D Code	Code 39	0.051 mm (2.0 mil)
GS1-Databar	QR Code, Data Matrix	0.084 mm (3.3 mil)

Minimum Resolution Conditions

Condition	Description
Distance	45 mm from the front edge of the scan engine
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

8.5 Barcode Width

100 mm (SR Models)
80 mm (HD Models)
40 mm (UD Models)

Barcode Width Conditions

Condition	Description
Barcode Sample	0.20 mm Code 39, specified in Chapter 8
Distance	170 mm from the front edge of the scan engine (SR models) 140 mm from the front edge of the scan engine (HD models) 75 mm from the front edge of the scan engine (UD models)
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

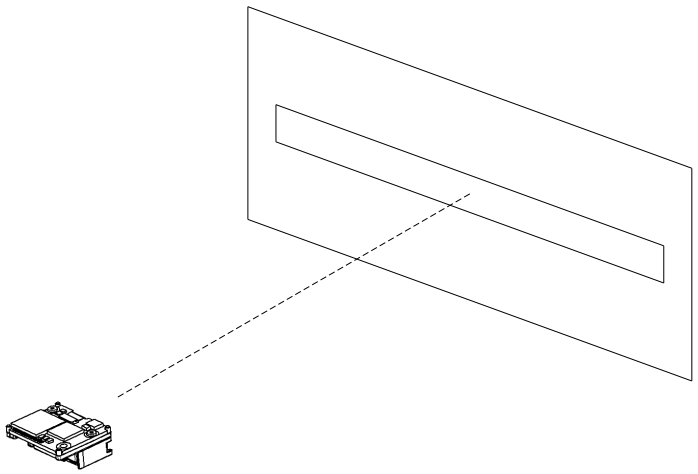


Figure **12***: Barcode Width*

8.6 Pitch, Skew, and Tilt

For pitch angle and tilt angle measurements, set the skew angle β to +15°.

Pitch, Skew, and Tilt

Orientation	Description
Pitch	α = ±65° (SR models) α = ±60° (HD models) α = ±50° (UD models)
Skew	β = ±65° (SR and HD models) β = ±50° (UD models)
Tilt	γ = 360°

Pitch, Skew, and Tilt Conditions

Condition	Description
Barcode Sample	0.5 mm Code 39 specified in Chapter 8 (SR and HD models) 0.127 mm Code 39 specified in Chapter 8 (UD models)
Distance	130 mm from the front edge of the scan engine (SR models) 100 mm from the front edge of the scan engine (HD models) 50 mm from the front edge of the scan engine (UD models)
Curvature	R = ∞

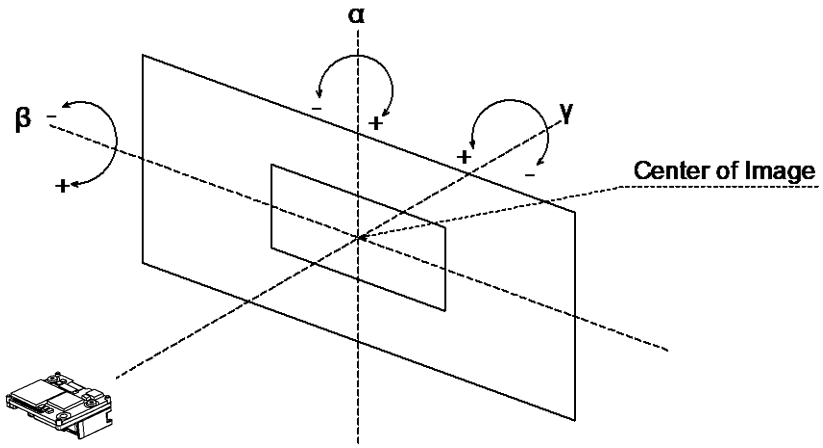


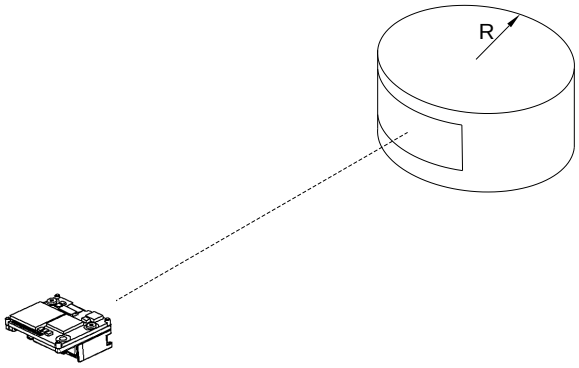
Figure **13***: Pitch, Skew, and Tilt*

8.7 Curvature

0.33 mm 12-digit UPC R ≧ 20 mm (SR and HD models)
R ≧ 22 mm (UD models)

Curvature Conditions

Condition	Description
Barcode Sample	0.33 mm UPC. For details, see section 8.1 “Barcode Test Labels.”
Distance	115 mm from the front edge of the scan engine (SR models) 100 mm from the front edge of the scan engine (HD models) 80 mm from the front edge of the scan engine (UD models)
Angle	α = 0°, β =+15°, γ = 0°



Note: If the surface is highly reflective, the illumination LED may be reflected and cause scanning to fail.

Figure **14***: Curvature*

8.8 Motion Tolerance

2.54 m/s (SR models)
1.0 m/s (HD models)

Motion Tolerance Conditions

Condition	Description
Ambient Temperature and Humidity	Room temperature and Room humidity
Ambient Light	500 lux to 1000 lux (on the surface of the barcode)
Distance	130 mm from the front edge of the scan engine (SR and HD models)
Skew	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage (MDI-4000, MDI-4100-HD)	3.3 V and 5.0 V
PCS	0.9 or higher
Barcode Sample	UPC with 0.33 mm resolution as specified in Chapter 8

Note: Successful reading at the indicated speed cannot be guaranteed. If the surface is highly reflective, the illumination LED may be reflected and cause scanning to fail.

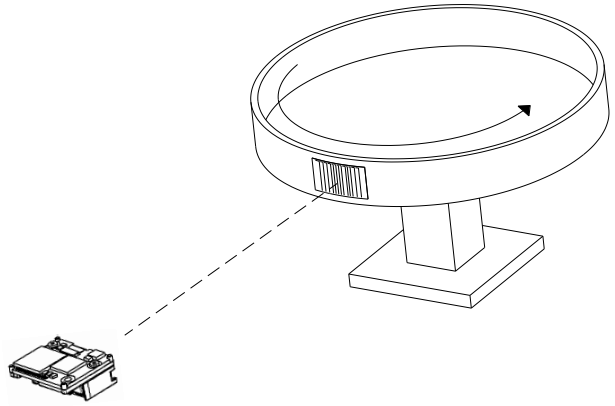


Figure **15***: Motion Tolerance*

8.9 Scan Speed

Number of scans per second:

1D Code: 40 scans/sec.
2D Code: 25 scans/sec.

Scan Speed Conditions

Condition	Description
Ambient Temperature and Humidity	Room temperature and Room humidity
Ambient Light	500 lux to 1000 lux (on the surface of a barcode)
Distance	115 mm from the front edge of the scan engine (SR models) 100 mm from the front edge of the scan engine (HD models) 80 mm from the front edge of the scan engine (UD models)
Scan Mode	Continuous scan
Angle	α = 0°, β =+15°, γ = 0°
Code Position	Center of the image
PCS (1D and 2D)	0.9 or higher
1D Code	UPC/EAN with 0.33 mm specified in Chapter 8
2D Code	Data Matrix with 0.254 mm specified in Chapter 8

Note: Performance is not guaranteed in other conditions.

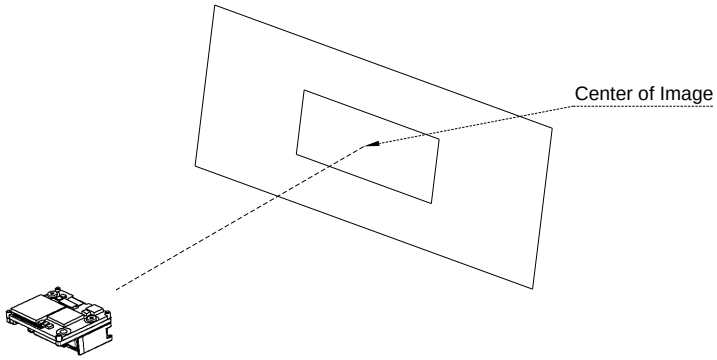


Figure **16***: Scan Speed*

9 Environmental Specifications

Unless otherwise noted, these conditions apply to all environmental specifications where applicable.

Environmental Specification Conditions

Condition	Description
Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	130 mm from the front edge of the scan engine (SR models) 120 mm from the front edge of the scan engine (HD models) 80 mm from the front edge of the scan engine (UD models)
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Scanning Test	Read at intervals of 300 ms
Power Supply Voltage	3.3 and 5.0 V

9.1 Temperature

Operating Temperature: -20 to 60 °C

Storage Temperature: -40 to 70 °C

9.2 Humidity

Operating Humidity 5 to 90% RH (no condensation, no frost)

Storage Humidity 5 to 90% RH (no condensation, no frost)

9.3 Ambient Light Immunity

Scanning performance is guaranteed when the illuminance on the surface of a barcode is between zero and the following values:

Incandescent Light	10,000 lux
Fluorescent Light	10,000 lux
Sunlight	100,000 lux

Note: Scanning performance is guaranteed if direct ambient light does not enter the light receiving section of the scan engine.

9.4 Electrical Noise

9.4.1 Scanning Symbologies

Scanning performance is not affected when the electrical noise added to the power supply pin is less than 0.1Vpp and has a frequency between 50 Hz and 100 kHz.

9.4.2 Image Data Acquisition

Acquiring image data is guaranteed to be accurate as long as the added sinusoidal electrical noise is less than 50 Hz to 100 kHz and 20 Vp-p.

Note: Electrical noise may affect the quality of captured images. The signal processing system of the scan engine is specifically designed to scan symbologies, not acquire images. Therefore, images captured by the scan engine may be of lower quality than those captured by general purpose digital cameras.

9.5 Vibration Strength

The scan engine is guaranteed to withstand the conditions of the following vibration test.

Vibration Test: Increase the frequency of the vibration from 12 Hz to 200 Hz at accelerated velocity 32.3 m/s 2(3.3G) for ten minutes. Continue this routine for 2 hours to X-direction, 2 hours to Y-direction, and 4 hours to Z-direction.

9.6 Drop Impact Strength

The scan engine is guaranteed to withstand the conditions of the following drop test.

Drop test: Fix the MDI-4000 Series scan engine in a specific aluminum-made dummy case 100x70x50 (WDH mm) and drop it 10 times in total: at the top, bottom, front, back, left, right, top-left, top-right, bottom-left, and bottom-right faces, from a height of 1.8 meters onto a concrete floor.

10 Integration Specifications

To connect the scan engine to a host system, use an FFC or FPC cable designed to meet the specifications provided by the connector manufacturer.

Recommended connector: Product No.: 9681-12 (12-pin, 0.5 mm pitch, 0.3 mm thick), produced by IRISO Electronics Co., Ltd.

Recommended cable length: Typ. 50 mm. The impedance caused by the length of the cable must not drop the voltage to the scan engine below 3.0V.

11 Regulatory Specifications

LED Safety:

IEC62471:2006 Exempt Group

12 RoHS

The MDI-4000, MDI-4050, MDI-4100, and MDI-4150 are compliant with RoHS.

Note: RoHS: The restriction of the use of certain hazardous substances in electrical and electronic equipment, 2011/65/EU.

13 Reliability

MTBF: 395297 hours

Note: The reliability of the scan engine is guaranteed as far as it is operated under normal operating conditions in the range of advised operating temperature and without excessive electrical or mechanical shock.

14 Precautions

All work benches, tools, measuring instruments, and any part of the human body that may come into contact with the scan engine must be treated with an anti-static agent.

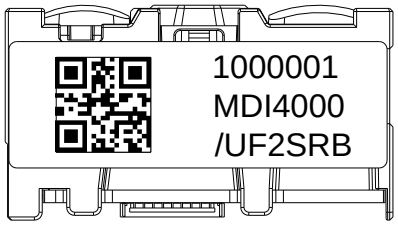
Do not touch the optical and electrical components. When possible, hold the camera body when handling the scan engine.

Avoid handling the scan engine in a dusty area. If dust gets on the scan engine, gently blow it off with dry air. Direct contact with the optics of the scan engine may reduce its performance.

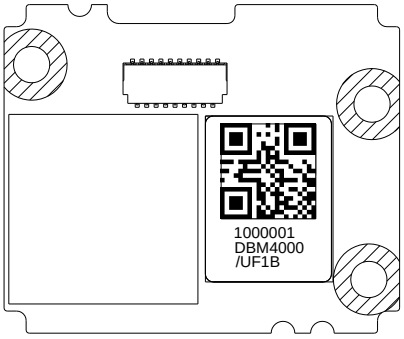
Do not drop the scan engine.

15 Serial Label

The serial label is affixed to the camera or decoder board. These illustrations show the serial labels for the MDI-4000. Serial labels for all other models are similar.



MSI-4000 Camera Label



DBM-4000 Decoder Board Label

Figure **17***: Serial Labels*

This illustration shows the label details for MDI-4100 SR. Serial label details for all other models are similar.

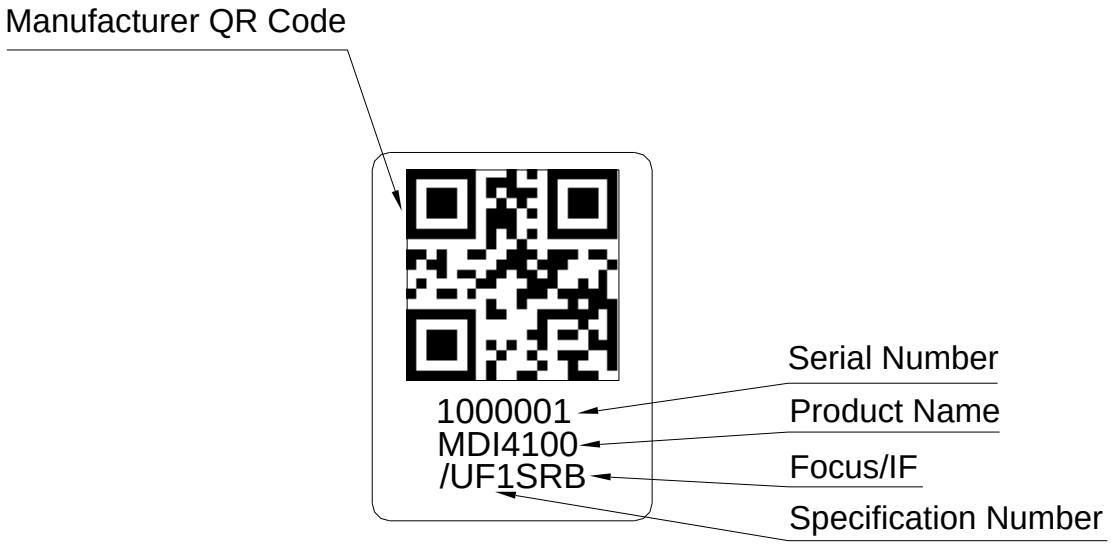


Figure **18***: Serial Label Details*

Serial Label Information

Information	Description	
Manufacturer QR Code	QR Code used by the manufacturer.	
Serial Number	Seven-digit number that starts at 1000001. Scan engines are sequentially numbered, regardless of lot number.	
Product Name	MDI4xxx	
Specification Number	Specification number of the manufacturing specification sheet (MSS).	
Focus/IF	SR: Standard Range Focus. HD: High Density Focus. UD: Ultra-High Density Focus	B: UART interface in default. DC: USB-COM interface in default. D: USB-HID interface in default.

16 Packaging Specifications

16.1 Packaging

A carton box: 450 pieces (MAX)

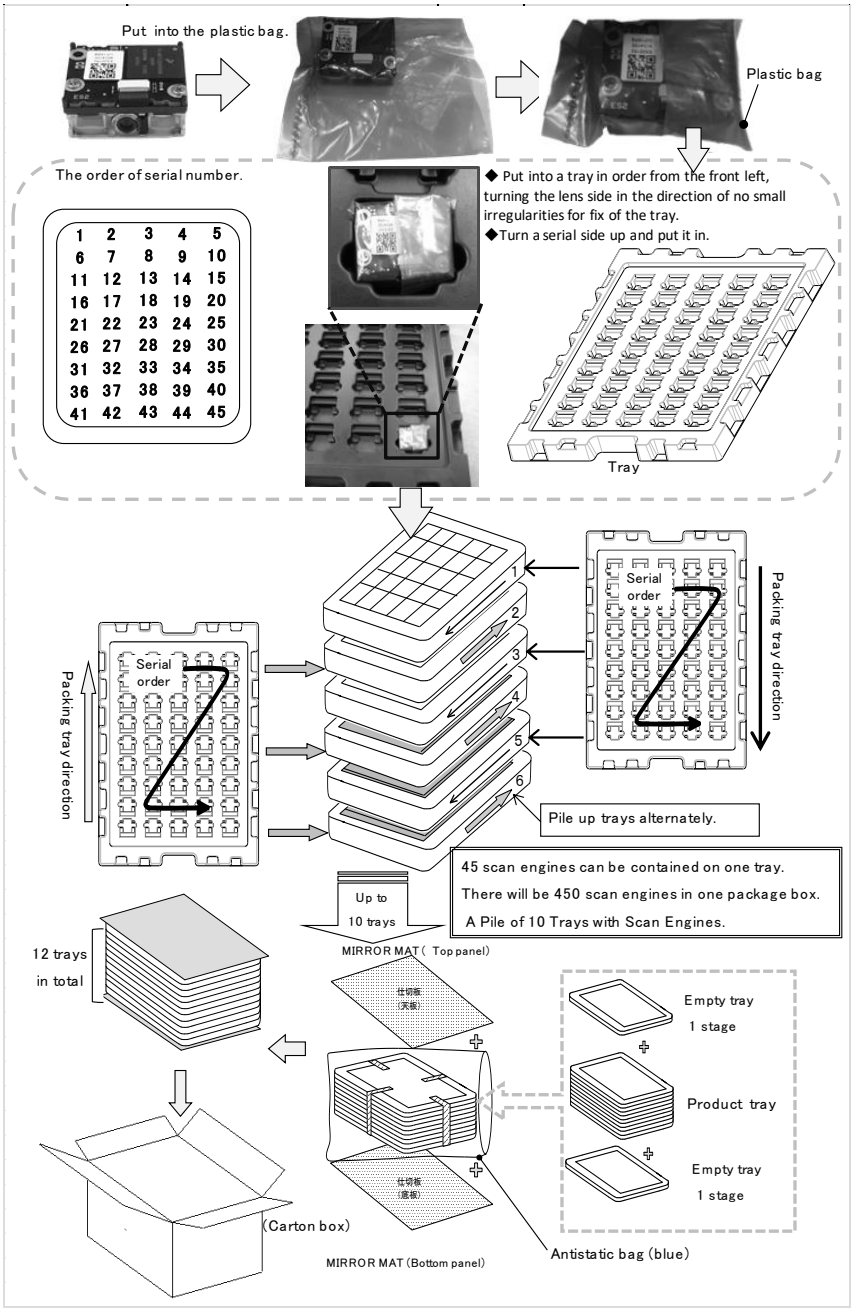


Figure **19***: Packaging*

The packing box displays the product name, number of products contained within and the name of the manufacturer are displayed on the packing box.

16.2 Package Size

Outer Dimensions: W: 365 mm, D: 295 mm, H: 225 mm

Note: The “RO” mark labelled on the package tray or package box guarantees that the applicable product has passed our test of RoHS restrictions compliance (the restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95 EC). However, this mark does not have any legal weight in the European Union.

17 Mechanical Drawing

17.1 MDI-4000 and MDI-4050 Mechanical Drawing

Camera

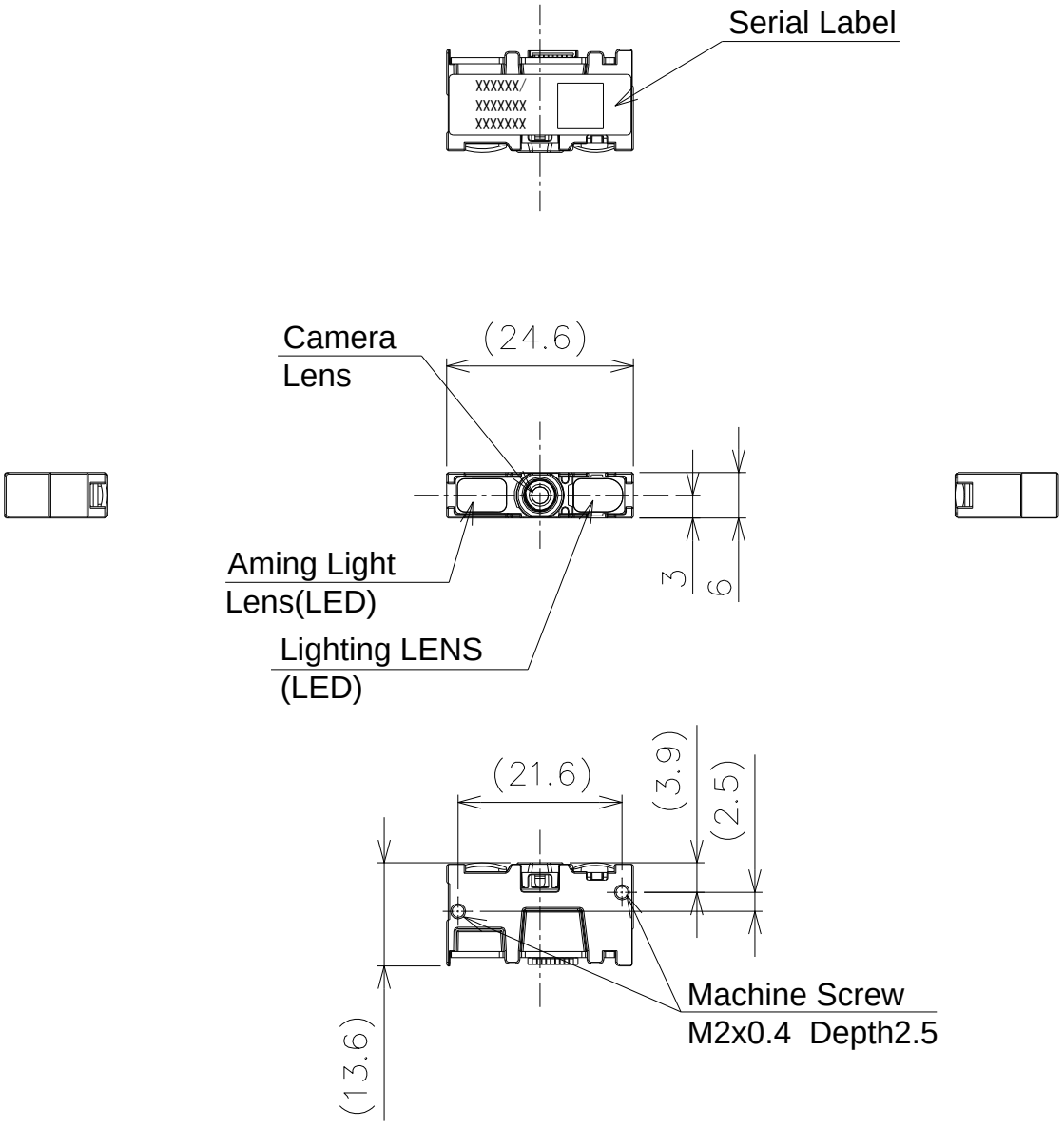


Figure **20***: MDI-4000 and MDI-4050 Camera Drawing*

MDI-4000 and MDI-4050 Decoder Board

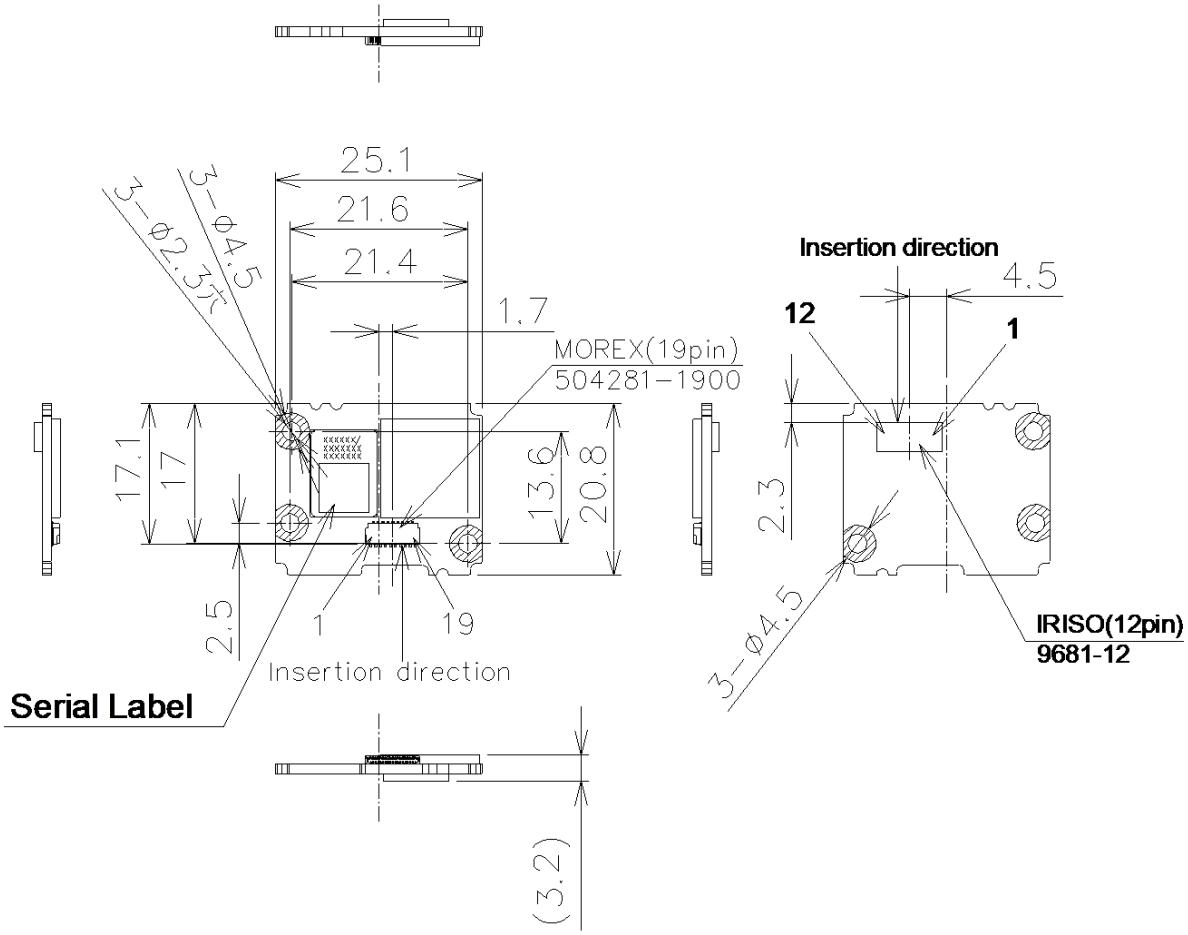


Figure **21***: MDI-4000 and MDI-4050 Decoder Board Drawing*

MDI-4000 and MDI-4050 FPC

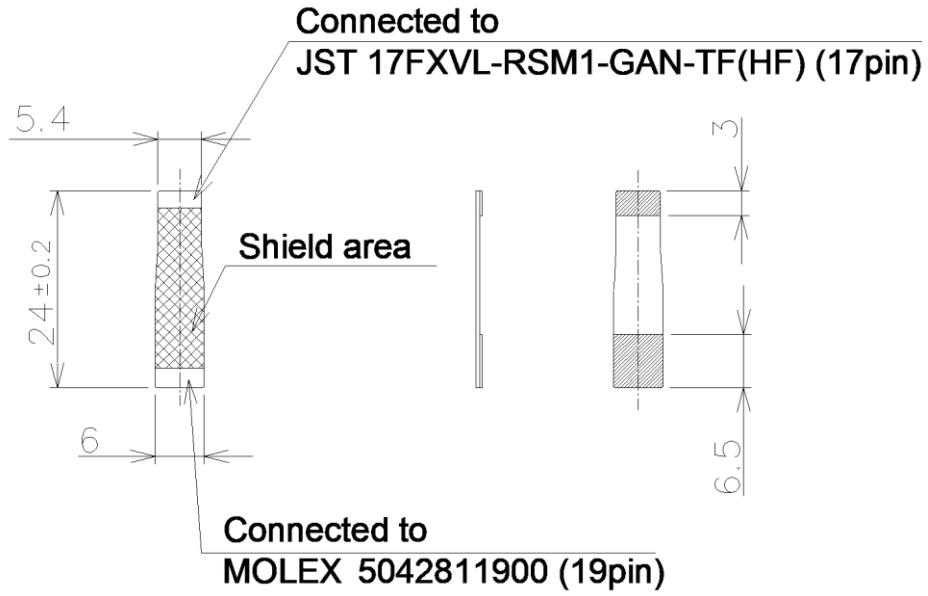
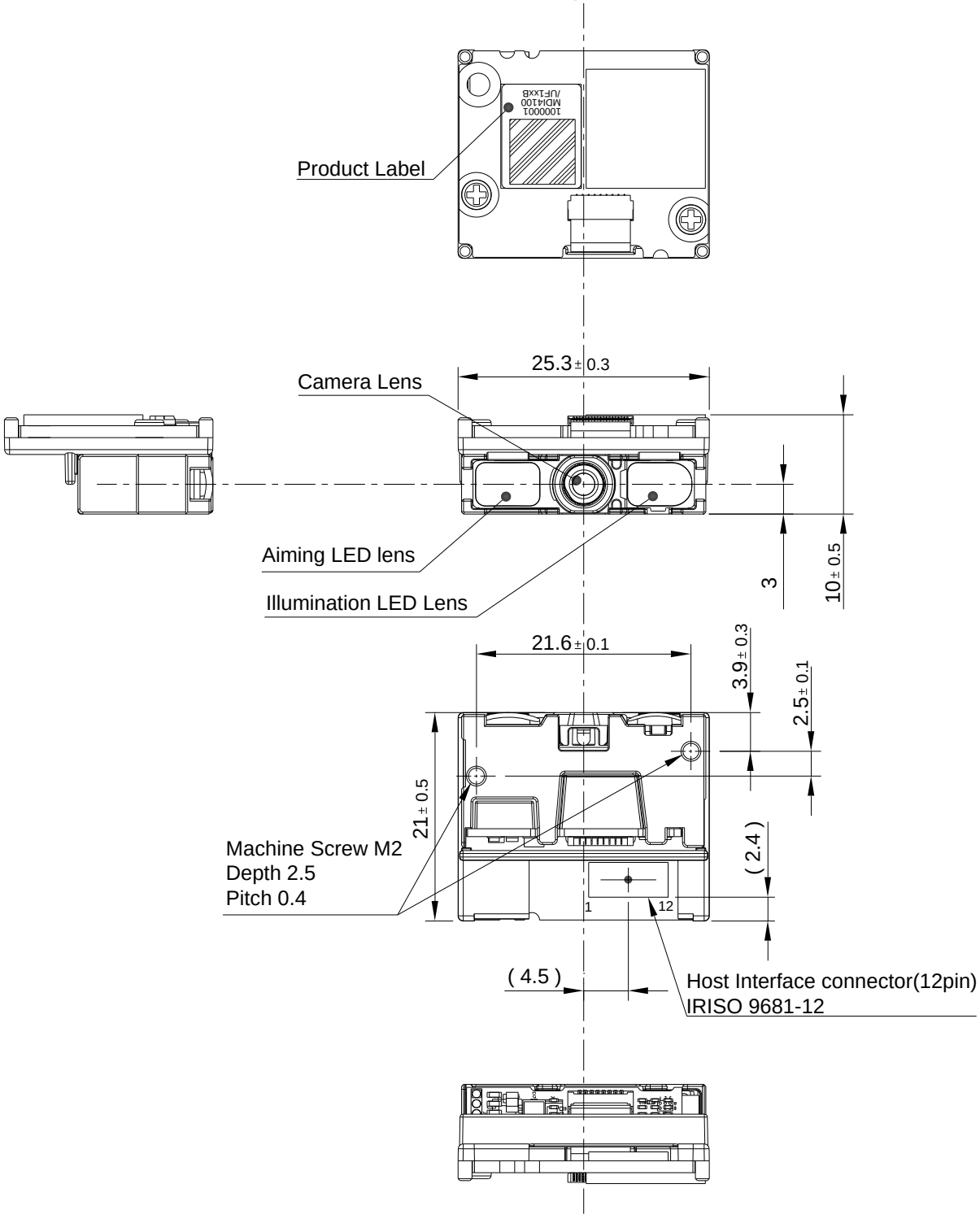


Figure **22***: MDI-4000 and MDI-4050 FPC Drawing*

17.2 MDI-4100 and MDI-4150 Mechanical Drawing



Note: This illustration shows the height for the MDI-4100: 10.0 mm. The height for the MDI-4150 is 9.7 mm.

Figure **23***: MDI-4100 and MDI-4150 Mechanical Drawing*